DOCUMENT RESUME

ED 479 575 IR 022 179

AUTHOR	Lytras, Miltiadis D.
TITLE	Semantics for E-Learning: An Advanced Knowledge Management Oriented Metadata Schema for Learning Purposes.
PUB DATE	2002-10-00
NOTE	9p.; In: E-Learn 2002 World Conference on E-Learning in Corporate, Government, Healthcare, & Higher Education. Proceedings (7th, Montreal, Quebec, Canada, October 15-19, 2002); see IR 022 093.
AVAILABLE FROM	Association for the Advancement of Computing in Education (AACE), P.O. Box 3728, Norfolk, VA 23514. Tel: 757-623-7588; e-mail: info@aace.org; Web site: http://www.aace.org/DL/.
PUB TYPE	Reports - Research (143) -- Speeches/Meeting Papers (150)
EDRS PRICE	EDRS Price MF01 Plus Postage. PC Not Available from EDRS
DESCRIPTORS	Computer Assisted Instruction; *Distance Education; Educational Development; Educational Environment; Instructional Development; *Knowledge Representation; Learning Strategies; Metadata; Semantics
IDENTIFIERS	*Knowledge Management

ABSTRACT

The research described in this paper is concentrated on the demand for high quality interchangeable knowledge objects capable of supporting dynamic learning initiatives. The general metadata models (Dublin Core, IMS, LOM, SCORM) for knowledge objects enrichment are reviewed and a critique is provided in order to claim the importance of the justification of an "interchangeable knowledge objects standard" for learning purposes. The overall objective is the justification of a dynamic learning environment capable of supporting the value diffusion. Discussion includes the reusability of learning content and metadata; reusability of learning content and knowledge management convergence; and multidimensional dynamic learning proposed metadata schema. (Contains 21 references.) (Author/AEF)

Reproductions supplied by EDRS are the best that can be made
from the original document.

ED 479 575

Semantics for E-learning: An advanced Knowledge Management oriented metadata schema for learning purposes

Mr. Miltiadis D. Lytras

Athens University of Economics and Business,
Department of Management Science and Technology, Greece
Email: mdl@aueb.gr

ABSTRACT

In recent years many researchers try to investigate the direct or indirect impact of knowledge management approaches to the achievement of strategic corporate objectives. Several approaches have been promoted, with main emphasis to be paid at the justification of knowledge exploitation processes (Nissen, Kamel et al. 2000), (Binney 2001), (Lee and Yang 2000), (John Garrick 2000), (Martensson 2000), (McAdam and McCreedy 1999). Our research effort is concentrated on the demand for high quality interchangeable knowledge objects capable to support dynamic learning initiatives. The general metadata models (Dublin Core, IMS, LOM, SCORM) for knowledge objects enrichment are been reviewed and a well justified critique is provided in order to claim the importance for the justification of an "interchangeable knowledge objects standard" for learning purposes. The overall objective is the justification of a dynamic learning environment capable of supporting the value diffusion.

Keywords: Knowledge management, E-learning, Semantics, Learning Objects Metadata

1.0 Introduction

The knowledge exploitation in modern era is recognized as a critical phenomenon. Several approaches (Kim and Mauborgne 1997), (Allee 1999) reveal the potential capacity of knowledge to empower the capacity for effective action. The development of dynamic learning environments requires a systematic justification of methods and processes that vary learning (unique value proposition) for every learner. In this direction a number e-learning techniques (Lytras and Doukidis 2000) (Ruttenberg, Spickler et al. 2000), (Bryans and Smith 2000) seem to be a common approach with uncertain performance (Lytras and Pouloudi 2001). This challenging situation sets a context that promotes the research in reusability of knowledge resources. A realization of reusability can be based on semantics that enrich general knowledge resources (e.g. an article, a journal paper, a PowerPoint presentation, e.t.c.). The ultimate objective is to expand the customization capabilities of learning environments and knowledge management seem to be a well justified mean for the achievement of such a goal (Lytras and Pouloudi 2001), (Lytras, Pouloudi et al. 2002).

1.1 Reusability of learning content and metadata

IR022179

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY

G.H. Marks

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

2B

BEST COPY AVAILABLE

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy

A major problem in the learning industry is the inability of the dominant e-learning platforms to support knowledge management mechanisms (Lytras, Pouloudi et al. 2002), (Lytras and Doukidis 2000) . This causes a number of limitations in the implementation of learning scenarios. Our research intents to justify a metadata schema and a correspondent logical schema in XML that support a dynamic e-learning environment. The current situation on metadata is described by a narrow vision on learning. The analysis of dominant metadata schemas that follows seems to be inadequate to exploit learning content.

Two basic problems concerning learning content are the codification and the diffusion. Traditional knowledge management approaches (Boisot 1987), (Hahn and Subramani 2000), promote critical guidance for the understanding of how these two problems can be solved. Diffusion basically incorporates two dimensions. The carriers of content and the learning scenario. Packaging of learning objects in operational modules or logical settings with relevant value for learners provides an integration of the two facets of key issues. XML language makes the packaging of learning content more flexible as it provides enormous capabilities for Document Type Definitions, or in simplest words a design language for the description of structure of documents or knowledge resources in general. This ascertainment, and the whole path of syllogism can be summarized in the following hypotheses:

H1: Is there a way for the enrichment of knowledge resources that parameterize a dynamic learning environment?
H2: Can we exploit the knowledge management theories of knowledge life cycles in order to present a constructive development of learning content?
H3: Can we justify a way for the packaging of learning content according to a knowledge activities perspective?
H4: Is there a metadata schema that is oriented to the knowledge activities and the learning exploitation?

The case of reusability of learning content is an open issue for the academic community (Zack 1999), (Abecker, Aitken et al. 1998), (Mahé and Rieu 1998), (Tautz and Gresse 1999), (Mentzas, Apostolou et al. 2001). It seems that a hidden convergence formulates a holistic approach. The cornerstone in this approach is the description of a common standard that supports the enrichment of digital contents with metadata or semantics. Our research effort goes a step further. It investigates the justification of a learning objects metadata schema that innovates in two ways. First of all it elaborates the knowledge management theories and second utilizes learning objects hierarchies (Bloom and Krathwohl 1984).

2.0 A synopsis of conceptual abstractions

The organization of knowledge in distinct objects, small structural components, is the basis of reuse. In the case of customized learning the same learning content can be used in many ways due to its integration with other knowledge objects.

Our approach is based on two clear assumptions that initiate the whole research:
A learning object is a synthesis of knowledge and metadata that expand further the learning effect of knowledge. From this perspective an e-learning environment has to utilize a learning objects base. A critical question is which metadata can we use in order to increase the learning effectiveness. A learning process is an abstraction of a logical sequence of learning activities or tasks. The conceptualization of learning processes determines an interface in which the components of a learning object can be realized. This layout is a value container, which is utilized by the embodiment of learning object. The critical

question is which learning processes can we use? And is there any hierarchy of learning processes that determine different value layers.

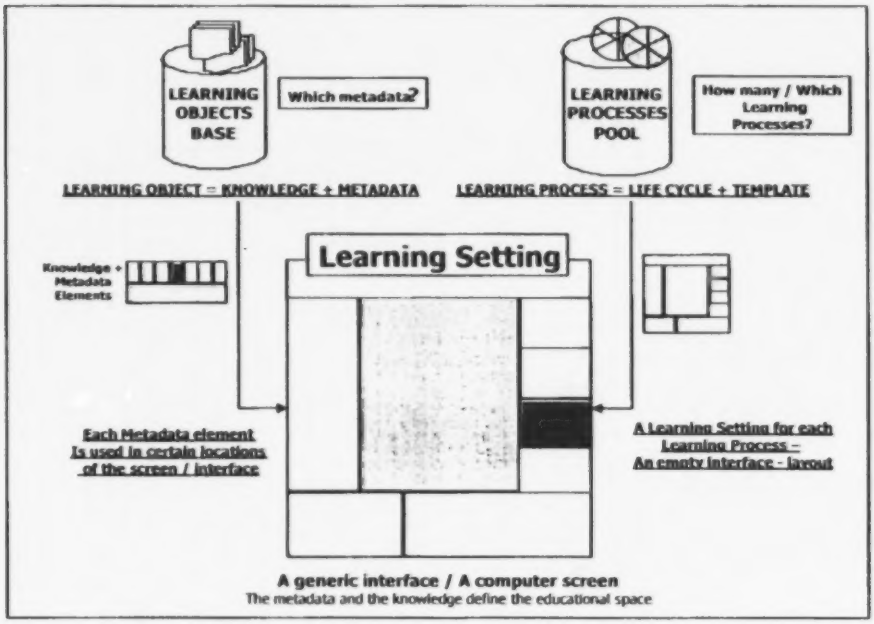
LEARNING OBJECTS BASE
Which metadata?
LEARNING PROCESSES POOL
How many / Which Learning Processes?
LEARNING OBJECT = KNOWLEDGE + METADATA
LEARNING PROCESS = LIFE CYCLE + TEMPLATE
Knowledge + Metadata Elements
Learning Setting
Each Metadata element Is used in certain locations of the screen / interface
A Learning Setting for each Learning Process – An empty interface - layout
A generic interface / A computer screen
The metadata and the knowledge define the educational space

Figure 1: The basic conceptual abstraction

2.1 Reusability of learning content and Knowledge Management Convergence

The underlying issue behind the packaging of knowledge is the re veal of a key idea that will support the accomplishment of a metadata scheme. Our proposition that has been developed after many implementations of elearning projects in our research unit, ELTRUN. (www.eltrun.aueb.gr) is that the convergence of knowledge management and e-learning is realized through an integrated life cycle model. Each step in this model that is depicted in figure two represents a value adding process. Each step sets a context for questioning about the required metadata that have to be attached to a generic knowledge source in order to formulate learning object. The first cycle summarizes a general Knowledge management framework where 6 processes / activities (Relate / Value, Acquire, Organize, Enable Reuse, Transfer, Use) make possible the management of knowledge object. The second cycle stands due to the assumptions that learning requires a further adoption of general knowledge sources. The six processes of the second cycle in figure two justify a learning orienting enrichment. The engagement of learners with the e-learning environment is becoming true through the employment of a number of learning processes.

BEST COPY AVAILABLE

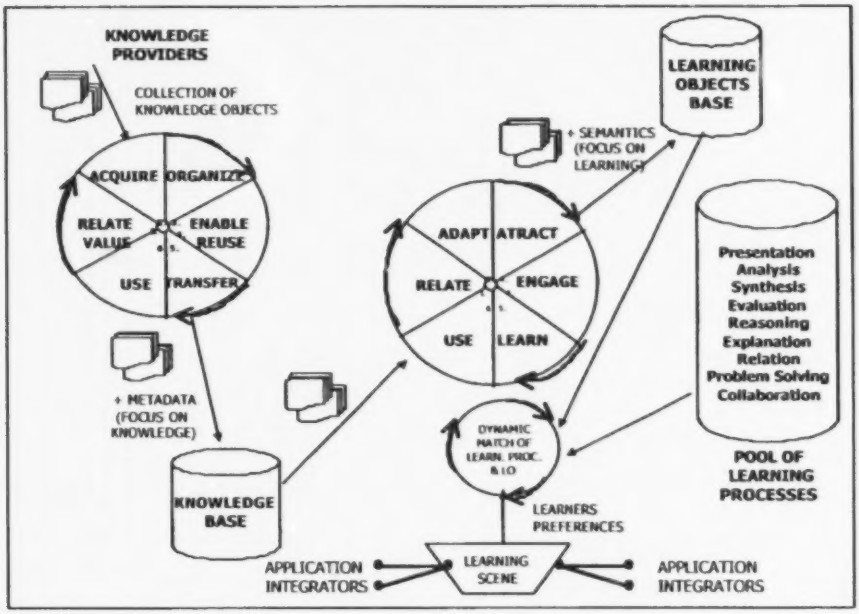

Figure 2: The Interchange Knowledge Flow

The key proposition in our approach is that a number of metadata can supports each step in the whole model and also the learning processes as learning objects containers. For the specification of the elements of this metadata scheme a review of well-known metadata schema has been undertaken.

2.2 Multidimensional Dynamic Learning Proposed Metadata Schema

Metadata are data about data (Brasethvik 1998), (Weitlaner 1999). In the context of learning, metadata are data about learning objects. This definition provides the major characteristic of metadata: They are descriptive indexing labels. Unfortunately for the case of learning this is not enough. The indexing of learning object it seems to be a management facility with limited impact on the realization of engagement of learners. A lot of approaches concerning metadata have been proposed for general or learning purposes. Some of the most well known organizations that work in metadata specifications are the Aviation Industry Computer-Based-Training Committee (AICC), the IEEE Learning Technology Standards Committee, the ARIADNE, the Educause Instructional Management Systems (IMS) Project, the World Wide Web Consortium (W3C), and the ADL. The need to specify metadata elements is translated to a two-fold requirement:(1). The specification of general metadata capable of supporting our theoretical proposition of general Knowledge Management Framework (see figure 2) and (2) the determination of metadata focusing on learning processes. The critical review of several metadata schemas including IEEE Learning Objects Metadata, IMS, Dublin Core, SCORM, GEM provides a rather superficial support for the second requirement and a sufficient support for the first one. The complexity of learning causes significant problems to the clarification of the practical dimension of what it means the achievement of different

BEST COPY AVAILABLE

educational goals. This gap in the propositions of the famous metadata schemas sets a context for significant contribution. The two advantages of the presented metadata schema s that cannot be explained further due to the limited space include:

(1). Shifts the key justification idea from indexing categories direct related to distinct roles or properties (e.g. Author, Technical Characteristics, Pedagogy) to value delivering processes (Knowledge & Learning Processes). (2). Provides advanced capabilities for extension. The 9 learning processes specified based on the work of Bloom (Bloom and Krathwohl 1984), and Tom Shuell are only some of the learning processes that can be modeled and used. For new learning processes modeled are required a number for new metadata schema elements.

If we justify the two sets of metadata then we can define in XML structures every knowledge resource. Potentially each knowledge resource can be enriched using a all the specified metadata elements. It can be also enriched to a limited extend. This incremental approach where a general knowledge resource can be exploited through the attachment of metadata secures a dynamic elearning environment.In the next section two tables present the proposed elements of the Multidimensional Dynamic Learning Metadata Schema. The first table summarizes the general metadata elements derived from a critical synthesis and evaluation of four famous metadata approaches. The second table summarizes the metadata elements that support the defined learning processes.

The usage scenario of these proposed metadata elements includes the manipulation of general knowledge sources and the attachment of all the required metadata. It is easily understood that potentially a knowledge provider can provide the whole metadata set accompanied to a resource. The learning process that will finally became the value driver and the mean for the diffusion of learning objects will specify the subset of metadata that will fill the layout of the specific learning process. It is obvious that the acceptance of this approach requires enormous efforts from the knowledge providers. This seem to be the most critical success factor since the dynamic development of a learning scenario requires the selection of some learning processes that deliver learning objects to the trainees. The next three tables provides a synopsis of the 3-level metadata specifications.

Metadata for general KM life cycle	
Relate / Value	Language, Subject, Quality, Main Concept
Acquire	Purpose, Title, Description, Creator, Publisher, Contributor, Identifier, Authors, and Institution
Organize	Date, Format, Location, Type, Source, Relation, Discipline, Sub discipline, Main concept, Main concept synonyms, other concepts, granularity
Transfer	Cost, Copyright & other restrictions, rights, Document type, Document handle, Document format, File size
Use	Operating system type, OS version, other platform requirements, Installation remarks, Access rights, restrictions, Usage remarks

Metadata for learning exploitation	
Relate	Interactivity Type, Interactivity Level, Intended End user role, Learning context, Typical Age Range, Typical Learning Time, Language, Relation, Coverage, Audience, Grade, Pedagogy, End user type, Didactical context
Adapt	Metadata (author, creation date, last modified date, language, validator, validation date)
Attract	Semantic density, difficulty, Description, Standards, Quality, Duration, Difficulty Le vel, Interactivity Level
Engage	Essential Resources, Pedagogy, and Pedagogical Duration
Learn	Pedagogy teaching methods, pedagogy. Assessment, semantic density, annotation (annotator, creation date, content)

Metadata for Learning Processes	
Presentation	Summary, Purpose, Essential Resources, Annotation, Topics, and Search Guidance
Analysis	Summary, Purpose, Conceptual Components, Typical Relations, Annotation, Relevant Topics, Search Guidance, Analysis conclusions, Collaboration Details
Synthesis	Summary, Purpose, Relevant Knowledge Objects, Typical Relations, Conceptual Components, Annotation, New Meaning, Draw Relations, Search Guidance, Recommended Conclusions, Conclusions, Collaboration Details, Guidance
Evaluation	Purpose, Relevant Knowledge Objects, Summary, Collaboration Details, Guided Theories, Guidance, Application Session, Simulation Session, Annotation, New Meaning, Conclusions, Recommended Conclusions
Reasoning	Summary, Purpose, Relevant Knowledge Objects, Annotation, New Meaning, Guidance, Conclusions, Recommended Conclusions, Starting Points, Collaboration Details
Explanation	Summary, Purpose, Relevant Knowledge Objects, Topics, Typical Relations, Draw Relations, Annotation, New Meaning, Guidance, Collaboration Details, Recommended Conclusions
Relation	Summary, Purpose, Relevant Knowledge Objects , Main Concepts, Draw Relations, New Meaning, Annotation, Guidance, Typical Relations, Conclusions, Collaboration Details
Problem Solving	Summary, Purpose, Relevant Knowledge Objects, Present Problem, Sub problems, Main Concepts , Collaboration Details, New Meaning, Annotation, Guidance, Conclusions
Collaboration	Summary, Purpose, Recording, Annotation, Findings

3.0 Conclusions

The overall approach described in the limited space of this paper provides a context for exploitation focusing on learning. The incremental refinement of conceptualization drives to a set of metadata that can assist the transformation of knowledge resources to reusable learning objects. This step-by-step justification finally drives an extensive XML specification of the metadata schema. The selection of learning processes as the carrier of value expands the dynamic nature of an e-learning system. The whole approach seems to integrate the two well-defined and distinct approaches to knowledge management, the knowledge artifact and the knowledge activities approaches. Future research is concentrated on the analysis and the development of a dynamic e-learning environment based on the key ideas of Knowledge Interchange Concept. For this scope an IST proposal is going to be prepare. We welcome any collaboration that will support the refinement of this proposal.

References

Abecker, A., S. Aitken, et al. (1998). KARATEKIT: Tools for the knowledge-creating company. Knowledge Acquisition for Knowledge-Based Systems Workshop (KAW'98), Banff, Alberta, Canada, April 18-23., http://ksi.cpsc.ucalgary.ca/KAW/KAW98/abecker.

Allee, V. (1999). "New tools for new economy." Perspectives on Business and Global Change, World Business Academy **Vol. 13**(No. 4).

Bloom and Krathwohl (1984). Taxonomy of Educational Objectives, Handbook I: Cognitive Domain. New York, Addison-Wesley and Co.

Boisot (1987). Information and Organizations: The Manager as Anthropologist. Fontana/Collins, London.

Brasethvik, T. (1998). A Semantic Modeling approach to Metadata. CAGIS project, funded by the Norwegian Research Council.

Bryans, P. and R. Smith (2000). "Beyond training: reconceptualising learning at work." The Journal of Workplace Learning **Vol. 12**(6): pp. 228-235.

Hahn, J. and M. Subramani (2000). A Framework of Knowledge Management Systems: Issues and Challenges for Theory and Practice. 21st Annual International Conference on Information Systems, ICIS 2000,, December 10-13, 2000 at the Brisbane Convention and Exhibition Centre, Brisbane, Australia.

Kim, C. and R. Mauborgne (1997). "Fair process: Managing in the knowledge economy." Harvard Business Review **75**(4): 65-75.

Lytras, M. D. and G. I. Doukidis (2000). Applied Knowledge Management in Education: E-school Architecture. In Dan Remenyi (Eds) proceedings of the 1st European Conference on Knowledge Management (ECKM 2000) , October 26-27, 2000, Bled, Slovenia, pp. 115-122.

Lytras, M. D. and G. I. Doukidis (2000). 'E-learning evaluation criticism. The Multidimensional Dynamic e-Learning Model'. The Fourth IASTED International Conference on Internet and Multimedia Systems and Applications (IMSA 2000) [CD Proceedings], ,November , 20-23, 2000, Las Vegas, Nevada, USA, pp. 368-373.

Lytras, M. D. and A. Pouloudi (2001). E-learning: Just a Waste of Time. In Strong, D., Straub, D. & DeGross, J.I. (Eds) Proceedings of the Seventh Americas Conference on Informaton Systems (AMCIS), Boston, Massachusetts, pp. 216-222.

Lytras, M. D. and N. Pouloudi (2001). "Expanding e-learning effectiveness. The shift from content orientation to knowledge management utilization". Word Conference on Educational Multimedia, Hypermedia and Telecommunications (ED-MEDIA 2001), June 25-30, 2001, Tampere, Finland (CD Proceedings).

Lytras, M. D., N. Pouloudi, et al. (2002). "Implementing knowledge management in learning: an advanced framework for technology and learning convergence in work environments." Journal of International Forum of Educational Technology & Society and IEEE Learning Technology Task Force, (accepted for publication in the special issue of April 2002).

Lytras, M. D., N. Pouloudi, et al. (2002). "Knowledge Management Convergence: Expanding Learning Frontiers. Journal of Knowledge Management," Journal of Knowledge Management **Vol. 6**(1): 40-51.

Mahé, S. and C. Rieu (1998). A Pull Approach to Knowledge Management. Using IS as a knowledge indicator to help people know when to look for knowledge reuse. 2nd International Conference on Practical Aspects of

Knowledge Management (PAKM98), Basel, Switzerland, 29-30 Oct. 1998.

Mentzas, G., D. Apostolou, et al. (2001). "Knowledge networking: a holistic solution for leveraging corporate knowledge." Journal of Knowledge Management **Vol. 5**(1): pp. 94-107.

Ruttenberg, B., G. Spickler, et al. (2000). E-learning: The engine of the knowledge economy, MORGAN KEEGAN, http://www.internettime.com/itimegroup/morgankeegan.pdf.

Tautz, C. and C. Gresse (1999). A Representation Formalism for Supporting Reuse of Software Engineering Knowledge. Expertensysteme 99 (XPS-99), Würzburg, Germany.

Weitlaner, E. (1999). Metadata Visualization. Institute for Information Processing and Computer Supported New Media (IICM). Graz, Austria, Graz University of Technology.

Zack, M. H. (1999). "Managing Codified Knowledge." Sloan Management Review , **Volume 40**(Number 4): pp. 45-58.

U.S. Department of Education
Office of Educational Research and Improvement (OERI)
National Library of Education (NLE)
Educational Resources Information Center (ERIC)

NOTICE

Reproduction Basis

[X] This document is covered by a signed "Reproduction Release (Blanket)" form (on file within the ERIC system), encompassing all or classes of documents from its source organization and, therefore, does not require a "Specific Document" Release form.

[ ] This document is Federally-funded, or carries its own permission to reproduce, or is otherwise in the public domain and, therefore, may be reproduced by ERIC without a signed Reproduction Release form (either "Specific Document" or "Blanket").